## P-136 - BIOREMEDIATION OF PETROLEUM-CONTAMINATED SOILS: MATHEMATICAL MODELLING AS A TOOL FOR THE SIMULATION OF ALTERNATIVE STRATEGIES

Gilberto Martins[1]; Ana Ferreira[1]; Rita Castro[1]; Wu Yanbo[2]; Alette A.M. Langenhoff[2]; Ana J. Cavaleiro[1]

1 - Centre of Biological Engineering, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal; 2 - Sub-department of Environmental Technology, Wageningen University & Research, Bornse Weilanden 9, 6708WG Wageningen, The Netherlands

### Background

Soil contamination with petroleum-based fuels constitutes a severe environmental problem affecting numerous locations worldwide. *In situ* bioremediation is an alternative to the more aggressive physico-chemical methods. Current knowledge on hydrocarbons biodegradation in soils is still limited and needs further research. In this work, a mathematical model was developed to understand the processes/variables involved in the microbial decontamination of a soil after an oil spill. Different biostimulation strategies were simulated, specifically by adding different electron acceptors.

### Method

A mathematical model was developed comprising the description of transport and transformation of petroleum in a saturated soil column. Hexadecane was chosen as a model compound, as alkanes are major constituents of petroleum fuels. The model was implemented in AQUASIM (Reichert, 1994), and addressed the adsorption/desorption of hexadecane, as well as aerobic and anaerobic biodegradation. Two different scenarios were considered: an organic soil column and a clay soil column. The influence of varying concentrations of electron acceptors was simulated (2.5 to 20 mg/L $NO_3^-$; 5 to 40 mg/L $SO_4^{2-}$; 10 mg/L $O_2$). Microbial degradation parameters were obtained from the literature, and the adsorption/desorption parameters were determined experimentally. For that, a series of batch assays was performed, in a range of hexadecane concentrations between 0 and 5 g/kg, for quantifying the partition of hexadecane in a soil/water mixture.

### Results & Conclusions

The results from the batch experiments showed that hexadecane mostly adsorb on soil particles (>60%) for all the concentrations tested. From the mathematical modelling, it was observed that for an initial concentration of hexadecane of 60 mg/kg, hexadecane in the solid phase decreases to 0.7 mg/kg at 1 m depth after 2.5 years. At 2 m deep, the concentration was 1.6 mg/kg after 3.5 years. For both soil types, adsorption/desorption, as well as washout by the water flux, exert a greater influence on hexadecane removal than the biological processes. This is mainly due to the slow removal rate of the anaerobic reactions. This model is a useful tool for stakeholders in decision support systems. It will assist on directing bioremediation efforts towards more efficient management and restoration of contaminated sites.

### References & Acknowledgments

References: Reichert P. (1994) Water Science and Technology 30, 21-30.

Acknowledgements: POCI-01-0145-FEDER-016575; ERC Grant n.º 323009; UID/BIO/04469/2013; POCI-01-0145-FEDER-006684; NORTE-01-0145-FEDER-000004; FCOMP-01-0124-FEDER-027462; SFRH/BPD/80528/2011.

**Keywords: Bioremediation, Hexadecane, Mathematical modelling, Soil**